PIVOTING ON-AXIS INK RESERVOIR FOR INKJET PRINTER

Technical Field

This invention relates to inkjet printing mechanisms, and more particularly, to an ink reservoir that is pivotally secured to the carriage of an inkjet printer thereby facilitating access to a printhead secured on the carriage below the ink reservoir.

Background of the Invention

An ink-jet printer produces images and text on a page by firing drops of ink from the printheads of one or more ink cartridges secured to a carriage, while the carriage moves back and forth across the page. Examples of ink-jet printers include plotters, facsimile machines, and typical computer-attached ink-jet printers. The page on which a printer prints may be any sheet of material, such as paper, Mylar, foils, transparencies, card stock, etc.

The ink supply of an ink-jet printer is limited. Thus, many cartridges are designed to be detachably secured and replaceable. A user simply replaces the old, empty ink cartridge with a new, full ink cartridge. In these so-called cartridge-type printers, the cartridges can be manufactured as a unit that includes a printhead and an ink reservoir (referred to as an "ink/printhead cartridge" herein). Thus, these types of ink/printhead cartridges are seated in a carriage that travels back and forth across the page during printing operation.

Since traditional ink/printhead cartridges each include an ink reservoir, an integral printhead, and the related electronics to operate the printhead, they are relatively expensive to manufacture and replace. These types of cartridges are typically sealed and do not allow individual components within them to be replaced. Accordingly, if either the printhead becomes inoperative or the ink supply becomes depleted, the entire cartridge must be replaced. As a result, the cost to operate and maintain such printers in necessarily increased.

Alternatively, in some designs commonly known as off-axis printers, the ink reservoir is a container that may be disconnected from the printhead, which remains installed on the carriage while the container is replaced. In the typical off-axis printer, only a printhead moves across the page, while the ink reservoir is stationary and secured to the base of the printer. Ink is delivered to an inlet port in the printhead via a flexible, ink delivery tube that extends from the stationary ink reservoir and usually requires a separate pump to deliver the ink. Typically, the ink reservoir is mounted to the printer chassis and may be replaced or refilled when empty. Off-axis printers may be equipped either with a single printhead for monochromatic printing, or with several printheads for color printing. Of course, for color printing, several reservoirs and associated tubes are required, with one set used for each color.

In the ink-delivery systems of off-axis printers, the ink-delivery tube may be permanently connected to the printhead, but this would prevent replacement of the printhead. The printhead may suffer mechanical breakdown or simply wear-out after firing millions of drops of ink. Therefore, the printheads of a typical ink-jet printer are designed to be replaced, as necessary. Similarly, the supply of ink in reservoirs or containers used in cartridge-type or off-axis type printers may be replenished in refill stations that are peripheral components of the printer system.

In practice, the expense associated with providing ink-delivery tubes and related delivery pumps necessarily increases the costs of manufacturing such printers. Moreover, forces generated by these types of ink-delivery systems can vary as the carriage traverses the paper. These varying forces can adversely affect carriage operation, including leading to premature wear of the carriage and compromised print quality.

With limited success, some inkjet printer designs have incorporated an ink reservoir and a separate printhead on the carriage, thereby avoiding the need for an off-axis ink delivery tube system. However, the placement and orientation of components for these designs has typically either compromised the ability to easily remove and replace the printhead, or required that the ink reservoir be removed before the printhead can be accessed. In designs where the ink reservoir must be removed either before or simultaneously with the removal of the printhead, the risk of loss or premature drying of the ink reservoir is increased.

Summary of the Invention

Accordingly, despite the available improvements offered by traditional inkjet printers and their on-axis and off-axis ink reservoirs, there remains a need for a printer having an on-axis ink reservoir that provides easy access to both the ink reservoir and the printhead, thereby facilitating easy and independent removal and replacement of either component. In addition to other benefits that will become apparent in the following disclosure, the present invention fulfills these needs.

The present invention is an on-axis ink reservoir that is pivotally secured to the carriage defining an engaged position, in which the ink reservoir is in fluid communication with a printhead secured to the carriage, and an open position, in which the ink reservoir pivots away from the printhead to allow easy access to the printhead. Preferably, the ink reservoir is detachably secured to an ink-reservoir mounting portion, the printhead is detachably secured to a printhead mounting-portion, and these two mounting portions are pivotally secured together. More preferably, the ink-reservoir mounting portion includes a plurality of ink reservoirs, and the printhead mounting-portion includes a plurality of printheads. A latching mechanism is provided to operably secure the two mounting portions together in the engaged position.

A fluid channel extends from the ink reservoir to the printhead when the carriage is in its engaged position. Preferably, the channel is substantially air tight between the ink reservoir and printhead such that a vacuum created by the printhead causes ink to flow through the channel. The substantially air tight seal is broken when the carriage is moved out of its engaged position, thereby preventing ink from flowing through the channel when the printhead is being replaced.

A resistive detent on one of the mounting portions operably engages a tab extending from the other of the mounting portions when the carriage is in its open position, thereby holding the carriage in its open position to further facilitate remove of the printhead.

Brief Description of the Drawings

FIG. 1 is a simplified perspective view of an inkjet printer having a carriage in accordance with a preferred embodiment of the present invention.

FIG. 2 is an enlarged and exploded isometric view of the carriage of Fig. 1.

FIG. 3 is an enlarged, isometric view of first and second detachable key elements in accordance with a preferred embodiment of the present invention.

FIG. 4 is an enlarged, isometric view of a partial carriage cover in accordance with a preferred embodiment of the present invention.

FIG. 5 is a fragmentary, side view of the carriage of FIG. 2 along line 5-5 of FIG. 2 with an uninstalled detachable ink reservoir shown and the same ink reservoir installed on the carriage shown in hidden lines.

FIG. 6 is an enlarged, isometric view of a biasing spring in accordance with a preferred embodiment of the present invention.

FIG. 7 is an enlarged, rear, isometric, view of the first separable key element of FIG. 3.

FIG. 8 is an enlarged, rear, isometric, view of the second separable key element of FIG. 3.

FIG. 9 is a side view of the carriage of FIG. 2.

FIG. 10 is an enlarged, fragmentary view of the carriage of FIG. 9 along line 10-10 of FIG. 9.

FIG. 11 is an enlarged, fragmentary view of the carriage of FIG. 9 taken along line 11-11 of FIG. 10 showing a closed position in solid lines and a possible open position in broken lines.

FIG. 12 is a side view of the carriage of FIG. 2 showing a possible unlatched position of the carriage.

FIG. 13 is a side view of the carriage of FIG. 2 showing a possible open position of the carriage.

Detailed Description

A printer 20 having an on-axis ink reservoir 24a, 24b that provides easy access to both the ink reservoir 24a, 24b and at least one printhead 32 is shown in FIGS. 1-13.

A. General Assembly

FIG. 1 illustrates an embodiment of an inkjet printing mechanism, here shown as an inkjet printer 20, constructed in accordance with the present invention, which may be used for printing business reports, correspondence, desktop publishing, and the like, in an industrial, office, home or other environment. A variety of inkjet printing mechanisms are commercially available. For instance, some of the printing mechanisms that may

embody the present invention include plotters, portable printing units, copiers, cameras, video printers, and facsimile machines, to name a few. For convenience, the concepts of the present invention are illustration in the environment of an inkjet printer 20.

While it is apparent that the printer components may vary from model to model, the typical inkjet printer 20, shown in FIG. 1, includes a chassis 26, a print medium handling system 28 for supplying sheets of print media to the printer 20, and a movable print carriage 30 for moving printheads 32 relative to the print medium at a print zone 34. The print media may be any type of suitable sheet material, such as paper, card-stock, transparencies, mylar, foils, and the like, but for convenience, the illustrated embodiment is described using paper as the print medium. The print medium handling system 28 moves the print media into a print zone 34 from a feed tray to an output tray 36, for instance, using a series of conventional motor-driven rollers (not shown).

In the print zone 34, the media sheets receive ink from a printhead 32. Each printhead 32 has bottom surface 38 comprising an orifice plate with a plurality of nozzles formed therethrough in a manner well known to those skilled in the art. The illustrated printheads 32 are thermal inkjet printheads, although other types of printheads may be used, such as piezoelectric printheads. The printheads 32 typically include a plurality of resistors which are associated with the nozzles. Upon energizing a selected resistor, a bubble of gas is formed ejecting a droplet of ink from the nozzle and onto a sheet of paper in the print zone 34 under the nozzle.

The printheads 32 are transported by the carriage 30, which may be driven by a conventional drive belt/pulley and motor arrangement (not shown) along a guide rod 40. The guide rod 40 defines a scanning direction or scanning axis along which the printheads 32 traverse over the print zone 34. The printheads 32 selectively deposit one or more ink droplets on a print media page located in the print zone 34 in accordance with instructions received via a conductor strip from a printer controller (not shown), such as a microprocessor which may be located within chassis 26. The controller may receive an instruction signal from a host device, which is typically a computer, such as a personal computer. The printhead carriage motor and the paper handling system drive motor operate in response to the printer controller, which may operate in a manner well known to those skilled in the art. The printer controller may also operate in response to user inputs provided through a keypad. A monitor coupled to the host computer may be used

to display visual information to an operator, such as the printer status or a particular program being run on the computer. Personal computers, their input devices, such as a keyboard and/or a mouse device, and monitors are all well known to those skilled in the art.

In particular, the print medium is fed from print media input stack in input tray through a print medium feed mechanism (not shown). The print medium is then advanced by rollers (not shown) in a direction perpendicular to a guide rod 40, while the print carriage 30 containing printheads 32 is moved back and forth on guide rod 40. Preferably, and shown in FIG. 2, the carriage 30 contains at least one printhead 32a and at least one detachable ink reservoir 24a in fluid communication with that printhead 32a. More preferably, the ink reservoir 24a is on-axis, both ink reservoir 24a and the printhead 32a are detachably secured to the carriage 30 at respective mounting portions 50, 52, and at least one of these mounting portions 50, 52 includes a separable key element 22a, 22b for ensuring that the proper printer components are inserted into the proper mounting bases 50, 52.

B. Carriage Assembly - On-Axis Ink Reservoirs

As best shown in FIGS. 2, 9, 12, and 13, the carriage 30 preferably includes an ink reservoir-mounting portion 50 pivotally secured to a printhead mounting-portion 52 at pivot point 56 defining an engaged position 58 of the ink reservoir-mounting portion 50 relative to the printhead mounting-portion 52 shown in FIG. 2, an open position 60 shown in FIG. 13, and an unlatched position 62 shown in FIG. 12.

One known way to pivotally secure these mounting portions 50, 52 together includes extending a shaft 64 from the pivot point 56 on one of the mounting portions 50, 52 into a mating hole received on the other of the mounting portions 50, 52. As best shown in FIGS. 10 & 11, the mating hole preferably includes a notched tab 66 sized to receive a mating end portion 68 of the shaft 64 only when the ink reservoir-mounting portion 50 is at a defined position relative to the printhead mounting-portion 52. Such an orientation allows a worker to quickly assemble these mounting portions 50, 52 together by positioning the mating end portion 68 of the shaft 64 through the notched tab 66. Moreover, once assembled, the mating end portion 68 serves to keep these two mounting portions 50, 52 together during operation of the assembled product.

The printhead mounting-portion 52 includes a guide rod-engaging portion 70 for operably engaging the guide rod 40 and the printhead mounting-portion 52 for operably receiving at least one detachable printhead 32 therein. Preferably, the carriage 30 shown in FIGS. 2, 9, 12, and 13 is sized to receive four printheads 32a-d (only printheads 32a, 32d are shown in the figures) so that it can print in a plurality of colors such as black, cyan, magenta and yellow. Each of the printheads 32a-d is in electrical communication with the printer controller to engage when commanded by the printer controller.

The ink reservoir-mounting portion 50 is sized and shaped to operably receive at least one detachable ink reservoir 24a, 24b therein. In particular, the ink reservoir-mounting portion 50 preferably includes a forward flange 72, rearward flange 74, left flange 76, and right flange 78 defining an ink reservoir chamber 80 therein. More preferably, the ink reservoir-mounting portion 50 includes at least one internal flange 82 defining a plurality of ink reservoir chambers 80a, 80b therein. The carriage 30 shown in FIGS. 2, 9, 12, and 13 is sized to receive at least two different detachable ink reservoirs 24a, 24b therein, a left ink reservoir 24a and a right ink reservoir 24b. One of the ink reservoirs, ((here the right ink reservoir 24b) preferably includes a plurality of ink chambers therein, thereby allowing it to store up to three different colors of ink. The other ink reservoir (here the left ink reservoir 24a) preferably includes a larger volume of a single color of ink. Accordingly, it can be filled with the most frequently used color of ink, which is usually black.

The chambers of ink in the detachable ink reservoirs 24a, 24b are in fluid communication with their respective printheads 32a-d and in electrical communication with the printer controller when the ink reservoirs 24a, 24b and printheads 32a-d are properly installed in the carriage 30 and the ink reservoir-mounting portion 50 and the ink reservoir-mounting portion 50 is in the engaged position 58 (FIG. 2). In particular, each ink reservoir 24a, 24b preferably includes a conductive electrical connector engaging portion (not shown) positioned to operably engage a corresponding electrical connector 90 when the ink reservoirs 24a, 24b are seated into their respective ink reservoir chambers 80a, 80b. Similarly, fluid channels 92 extend from openings (not shown) in the ink reservoirs 24a, 24b through the ink reservoir-mounting portion 50 to their respective printheads 32a-d when the ink reservoir-mounting portion 50 is in the engaged position 58.

Sub a7

1. Printhead Access

The pivoting connection between the ink reservoir-mounting portion 50 and the printhead mounting-portion 52 permits easy access to the printheads 32a-d for maintenance, service, or replacement. In particular, the carriage 30 can be positioned along the guide rod 40 to permit easy access to the carriage 30 through an access door 94 in the chassis 26 of the printer 20.

With the carriage 30 so positioned, the service lifts the ink reservoir-mounting portion 50 causing it to pivot about pivot point 56 and move to the open position 60, thereby exposing the printhead mounting-portion 52 and providing access to the printheads 32a-d.

Preferably, the ink supply from the ink reservoirs 24a, 24b to the printheads 32a-d is stopped when the carriage 30 is not in the engaged position 58 (FIG. 2). One known way to accomplish this is to maintain a substantially air tight seal between the ink reservoirs 24a, 24b and their respective printheads 32a-d when the carriage is in its engaged position 58 (FIG. 2). Accordingly, ejecting ink from the printheads 32a-d creates a vacuum in the fluid channels 92 that draws new ink from the ink reservoirs 24a, 24b into the channels. The substantial vacuum is broken when the carriage is moved out of its engaged position. Accordingly, no fluid flows through the channels 92 when the carriage is out of its engaged position.

Preferably, a rod 98 is positioned adjacent to each channel 92 and operably extends from the ink reservoir-mounting portion 50 to the printhead mounting-portion 52. As best shown in FIGS. 9 and 12, each rod 98 is biased to an extended position such that urging the ink reservoir-mounting portion 50 from its unlatched position 62 (FIG. 12) to its engaged position 58 (FIG. 2) causes each rod 98 to retract, thereby applying a force between the ink reservoir-mounting portion 50 and printhead mounting portion 52. This force facilitates maintaining the printheads 32a-d on the current datums.

Preferably, the fluid cannels 92 include interlocking nozzles 100 and mating recesses 102 on the ink reservoir-mounting portion 50 and the printhead mounting-portion 52 that interlock together when the ink reservoir-mounting portion 50 is in the engaged position 58 (FIG. 2), thereby allowing fluid to flow through the fluid channels 92 and making the connections substantially air tight. More preferably, retractable seals 104, that are biased to an extended position operably engage each nozzle 100 and mating

recess 102 connection when the ink reservoir-mounting portion 50 is in its engaged position 58, thereby preventing inadvertent leaking of air into the ink channels. Filters (not shown) are also preferably placed in the fluid path at these connections, thereby preventing inadvertent contamination the printheads 32a-d.

Sub Q2) As best shown in FIG. 10, in order to prevent the ink reservoir-mounting portion 50 from inadvertently falling out of its open position 60 during maintenance, a resistive detent 108 may be positioned in one of the ink reservoir-mounting portion 50 or the printhead mounting-portion 52. The resistive detent 108 operably engages a tab 110 extending from the other of the ink reservoir-mounting portion 50 or the printhead mounting-portion 52 when the ink reservoir-mounting portion50 is in its open position 60, thereby holding the ink reservoir-mounting portion 50 in place.

2. Carriage Latching Mechanism

Sub Q3) Preferably, a latching mechanism 112 is provided to secure the ink reservoir-mounting portion 50 in its engaged position 58 (FIG. 2). Moreover, because of the relatively large forces associated with deflecting the rods 98 of the ink flow valves out of their neutral positions, it is desirable that the latching mechanism 112 operate as a lever, thereby minimizing the amount of force required by a user to secure the lever. As best shown in FIG. 12, the latching mechanism 112 preferably includes a handle 114 pivotally secured to the ink reservoir-mounting portion 50 at a pivot 116 such that the handle114 defines a lever arm 118 on one side of the pivot 116 and a moment arm 120 on the other side of the pivot 116. A left and right joining arm 122a, 122b, respectively, are pivotally secured to the moment arm120 at a point spaced apart for the pivot 116. The opposite ends 124 of the joining arms 122a, 122b include openings 126 for receiving hooks 128 extending from the printhead mounting-portion 52.

As best shown in FIG. 12, to place the ink reservoir-mounting portion 50 in its engaged position 58, from its unlatched position 62 (FIG. 11), the user positions the openings 126 on the joining arms 122a, 122b over the hooks 128 extending from the printhead mounting-portion 52. The user then moves the lever arm 118 of the handle 114 in the direction of arrow 130 (FIG. 12). This action urges the ink reservoir-mounting portion 50 to pivot about the pivot 116 toward the printhead mounting-portion 52, drawing these two portions together. As the point where the left and right joining arm 122a, 122b pivot about the moment arm 120 rotates above and past a vertical plane

aligned along pivot 116, the forces urging the mounting portions 50, 52 apart actually lock these components together, further defining the engaged position 58 of the ink reservoir-mounting portion 50.

To release the ink reservoir-mounting portion 50 from its engaged position 58, a user simply lifts the lever arm 118 of the handle 114 in the direction of arrow 132 (FIG. 2). When the point where the left and right joining arms 122a, 122b contact the moment arm 120 crosses back over the vertical plane extending from pivot 116, the forces acting on the ink reservoir-mounting portion 50 urge the ink reservoir-mounting portion 50 into the unlatched position 62 of FIG. 12.

C. Detachable Printer Component Installation

Preferably, the printer 20 includes one or more devices to facilitate and ensure that the detachable printer components, such as the ink reservoirs 24a, 24b, are properly installed, seated and aligned in their appropriate mounting portions 50, 52.

1. "Toe-Heel" mounting portion cover

Detachable printer components, such as the ink reservoirs 24a, 24b of the present embodiment, can be installed into the ink reservoir-mounting portion 50 through a mechanism and procedure commonly referred to as a "toe-heel" installation. This term originates from the similar appearing procedure for putting a conventional ski boot in a ski binding. Namely, the skier first places their toe in a front binding on a ski then steps down on the ski to secure a rear binding around the heel portion of the boot. To facilitate understanding of this installation process in a printer 20, the following example is offered for the ink reservoirs 24a, 24b of the present invention. It should be appreciated by those skilled in the art that the principles of this procedure would work equally well with any other type of removable printer component, such as a traditional ink/printhead cartridge, printhead 32, or an off-axis mounted ink reservoir.

In particular, the ink reservoirs 24a, 24b each have a defined shape, such as rectangle defining a leading, toe end 140 and a rearward-mounting end 142. The ink reservoirs 24a, 24b are slightly smaller than the shape of their corresponding ink reservoir chambers 80a, 80b. Left and right toe-end guides 146a, 146b (only 146a is shown) extend from the left and right sides 148a, 148b of each ink reservoir 24a, 24b, and slidably engage guide rails 150 aligned along the respective left and right sides 148a, 148b of the corresponding ink reservoir chambers 80a, 80b, the guide rails 150 lead to

toe-end guide receptacles 152 toward the rear end 154 of the ink reservoir chambers 80a, 80b for operably securing the toe-end guides 146a, 146b therein. Front tabs (not shown) extend from the ink reservoirs 24a, 24b to operably engage mating tab mounting chambers 155 received in the ink reservoir chambers 80a, 80b.

The rearward-mounting end 142 of the ink reservoirs 24a, 24b preferably includes left and right rearward mounting end guides 158a, 158b sized to slidably engage respective mating slots 160a, 160b received on the respective side walls of the ink reservoir chambers 80a, 80b. A lever 162, operably secured toward the lower portion 164 of the rearward-mounting end 142 of the ink reservoirs 24a, 24b is biased to an extended position 166 (shown in FIG. 2). The lever162 includes a notch 168 extending therefrom for operably engaging a lip 170 (FIG. 5) on the forward flange 72 of the ink reservoir-mounting portion 50, thereby detachably securing the ink reservoirs 24a, 24b to the ink reservoir mounting portion 50.

Each ink reservoir 24a, 24b is installed into its respective ink reservoir chamber 80a, 80b by the installer first placing the toe end 140 into the respective ink reservoir chamber 80a, 80b such that the left and right toe-end guides 146a, 146b slidably engage guide rails 150. The user slides the toe end 140 of the ink reservoir 24a, 24b toward the toe-end guide receptacles152. When the toe-end guides 146a, 146b are seated in their respective receptacle 152, the user then presses down on the upper surface 172 of the ink reservoir 24a, 24b toward the rearward-mounting end 142, causing the left and right rearward mounting end guides 158a, 158b to slidably engage their respective mating slots 160a, 160b, and thereby properly positing the ink reservoirs 24a, 24b into their respective ink reservoir chambers 80a, 80b.

As best shown in FIG. 2, to encourage proper installation of the detachable printer component as described, a mounting portion cover 180 that extends above and partially over the ink reservoir chambers 80a, 80b can be operably mounted to the ink reservoir-mounting portion 50. In particular, the cover 180 includes a substantially planar top surface 182 positioned over the ink reservoir chambers 80a, 80b receiving the toe end 140 of the ink reservoirs 24a, 24b. The planar top surface 182 is positioned above each ink reservoir 24a, 24b when each ink reservoir 24a, 24b is fully installed on the ink reservoir-mounting portion 50, and it extends over the ink reservoirs 24a, 24b only by an amount that precludes it from interfering with the toe-heel installation previously described.

Accordingly, as best shown in FIG. 5, so long as the installer performs a toe-heel installation of the detachable printer component, the mounting portion cover 180 does not interfere with the installation.

Sub A5 However, if an installer attempts to install an ink reservoir 24a, 24b in another manner besides using the toe-heel installation process, the cover 180 blocks the toe end 140 of the ink reservoir 24a, 24b from entering the respective ink reservoir chambers 80a, 80b, thereby alerting the installer of the improper installation. For example, if an installer would first attempt to secure the notch 168 extending from the lever 162 to the lip 170 on the forward flange 72, and then attempt to lower the toe end 140 of the ink reservoir 24a, 24b into the respective ink reservoir chamber 80a, 80b, the mounting portion cover 180 blocks the toe end 140 of the ink reservoir 24a, 24b from entering the respective ink chamber 80a, 80b, thereby alerting the installer of the improper installation method. Similarly, if the installer attempts insert an ink reservoir 24a, 24b into the ink reservoir chamber 80a, 80b simply by maintaining the bottom surface 190 of the ink reservoir parallel to the lower surface 192of the respective ink reservoir chamber 80a, 80b, the mounting portion cover180 blocks the toe end 140 of the ink reservoir 24a, 24b from entering into the respective ink reservoir chambers 80a, 80b.

More preferably, as best shown in FIG. 5, the cover 180 is pivotally secured to the ink reservoir-mounting portion 50 at pivot point 194 by arms 196 that extend from the substantially planar top surface 182 and at least one beam spring 198 extends from the substantially planar top surface 182 to operably engage the rearward flange 74 of the ink reservoir-mounting portion 50, thereby biasing the cover 180 to a neutral position shown in FIG. 2. The beam spring 198 and pivot point 194 allow the substantially planar top surface 182 to deflect slightly upward during the toe-heel installation process, but also urge the deflected substantially planar top surface 182 and the toe end 140 of the ink reservoir 24a, 24b in contact with it, toward the respective ink reservoir chamber 80a, 80b, thereby further facilitating installation of the ink reservoir. The leading edge 200 of the substantially planar top surface 182 may be angled upward as best shown in FIG. 5, to further facilitate entry of the toe end 140 of the ink reservoir 24a, 24b below the cover 180.

The cover 180 is preferably a contrasting color from the ink reservoir-mounting portion 50 and printhead mounting-portion 52 of the carriage 30. The contrast in color

between these components makes the cover 180 appear more readily to an installer, thereby alerting the installer of this obstacle to improper installation of the ink reservoirs.

2. Helper Spring

As best shown in FIG. 5, a spring 210 is preferably operably secured within the ink reservoir chambers 80a, 80b to facilitate installation and remove of the ink reservoirs 24a, 24b. Preferably, the spring 210 biases each ink reservoir 24a, 24b to an uninstalled position 212 shown in solid lines in FIG. 5, but remains compressed while each respective ink reservoir 24a, 24b is latched in its installed position 214 shown in dashed lines in FIG. 5.

One known effective spring design for such a purpose is a beam spring 210 shown in FIG. 6. The spring 210 includes a generally c-shaped mounting portion 216 and an elongate beam portion 218 extending therefrom. The distal end 220 of the beam portion 218 can include an angled end 222 aligned to support each ink reservoir 24a, 24b in its uninstalled position 212. The c-shaped mounting portion 216 is preferably clipped to an arm 224 extending from the ink reservoir-mounting portion 50 below each respective ink reservoir chamber 80a, 80b. Preferably, each ink reservoir chamber 80a, 80b includes a recess 226 for receiving the spring 210 when each respective ink reservoir 24a, 24b is in its installed position 214 within the respective ink reservoir chamber 80a, 80b.

Known preferable materials for constructing the spring 210 include high yield stainless steel and beryllium copper. The specific shape of the spring may be changed to optimize its force and displacement characteristics. A particularly effective beam shape is a triangle having a wide base toward the c-shaped mounting portion 216 that narrows at it approaches the distal end 220 of the spring. A similarly shaped portion of material may be removed from the beam portion as shown in FIG. 6, thereby further enhancing the force characteristics provided by the spring 210.

The spring 210 facilitates installation of each ink reservoir 24a, 24b by encouraging a toe-heel installation of each ink reservoir 24a, 24b. Preferably, with an ink reservoir 24a resting in the uninstalled position 212 of FIG. 5 and with the spring 210 unloaded, the toe end 140 of that ink reservoir 24a is properly aligned such that the left and right toe-end guides 146a, 146b are operably received within their respective toe-end guide receptacles152. Moreover, the spring 210 facilitates easy removal of an ink

reservoir 24a by urging the rearward-mounting end 142 of the ink reservoir 24a up when the lever162 is unlatched.

Sub A6 Also, should an installer improperly latch the lever162 as described, the spring 210 will urge the rearward-mounting end 142 of the ink reservoir 24a upward, thereby visually alerting the user of the improper installation. Preferably, the printer chassis 26 includes defined stops (not shown) that operably engage the rearward-mounting end 142 when the ink reservoir 24a is in its uninstalled position 212 shown in FIG. 5. The location of the carriage 30 when the rearward-mounting end 142 contacts these stops can then be used to signal the user of the improper ink reservoir 24a installation via a computer interface, warning light, or the like.

D. Separable Key Element

Preferably, the printer includes one or more separable key elements 22a, 22b as best shown in FIGS. 2, 3, 7 and 8.

Sub A7 In general, each detachable printer component, such as the ink reservoirs 24a, 24b shown in FIG. 2, includes a unique pattern of identifying tabs 220a-f extending therefrom. For example, the left ink reservoir 24a includes tabs 220a-c, two of which are to the left of the left ink reservoir's lever 162, and the right ink reservoir 24b includes tabs 220d-f, two of which are to the right of the right ink reservoir's lever162. This pattern of tabs 220a-f can be used to indicate the type, color, and/or quality of ink contained that particular printer. For example, the tab pattern for the left ink reservoir 24a can indicate that it contains black ink, and the tab pattern displayed on the right ink reservoir 24b can indicate that the right ink reservoir is a multi-chamber reservoir containing blue, magenta, and yellow colored ink.

For a given printer 20, the correct location and orientation of the removable printer components are defined. For example, an ink reservoir containing black ink must be installed in an ink cartridge chamber that is in fluid communication with a black ink channel and related printhead. If a different color of ink were inadvertently placed in the channel and the corresponding printhead, these components would become contaminated and no longer function as designed. Accordingly, it is important that the correct ink supply be mounted in the correct ink chamber.

Each key element 22a, 22b includes a unique pattern of slots 224a-f to receive one of the available unique pattern of identifying tabs 220a-f therethrough, and preclude a

different pattern of identifying tabs 220a-f from passing therethrough. The key element 22 is operably secured to the ink reservoir-mounting portion 50 adjacent to the space occupied by the tabs 220a-c on one of the ink reservoirs 24a when that ink reservoir 24a is in its installed position on the ink reservoir-mounting portion 50.

Preferably, and as best shown in FIGS. 3, 7, and 8, each key element 22a, 22b includes a base-mounting portion 230 having a key tab portion 232, an identifying label tab portion 234, and a mounting portion 236 extending therefrom. The mounting portion 236 includes a mounting slot 238 sized to be received on the forward flange 72 of the ink reservoir-mounting portion 50 and a hook 240 for operably engaging the forward flange 72. More preferably, the forward flange 72 and mounting portion 236 include a unique set of mating slots 245, thereby preventing an incorrect key element 22 from being installed at that particular location on the forward flange 72.

As best shown in FIG. 3, the label tab portion 234 includes a display surface 244 for receiving a label 246, preferably having unique surface indicia 248 thereon indicating the type of detachable printer component that the key element will accept. For example, one label 246a can indicate the key element 22a to which it is attached receives a black ink reservoir. Similarly, a separate key label 246b installed on a separate key element 22b can indicate that the key element 22b to which it is attached receives a multi-color ink reservoir.

Preferably, each display surface includes a unique shape or orientation. For example, the display surface 244 on one key element 22b can have a flat bar 252 on the left side of the display surface and a rounded right side, while the display surface 244 on another key element 22a may place the flat bar 252 on the right side and have a rounded left side. Accordingly, the likelihood that an assembler may place the wrong label 246a, 246b, on the display surface 244 is reduced, because the correct label for each display surface 244 can have the same shape corresponding to the display surface to which it is correctly attached.

The foregoing key elements 22a, 22b may be detachably secured to the printer 20. Accordingly, a family of printers can rely on the same basic carriage 30 and the like to build a variety of different printers having different functionality. Configuration control for a given printer installation is regulated by the manufacture selecting the appropriate key elements 22a, 22b for that particular printer configuration.

Moreover, should the manufacture, customer, or service technician ever wish to change the configuration of a printer, say for example, to convert a black and white printer into a color printer, or upgrade a printer with improved components, after the appropriate printer components are replaced to accommodate the new printer configuration the key elements 22a, 22b need only be changed in order to re-key the ink reservoir chambers to accept the new ink reservoirs.

E. Alternative Embodiments

Even though the foregoing description has focused on the installation and positioning of an ink reservoir in an ink reservoir mounting portion of a carriage, it can be appreciated that the basic concepts of this invention will work equally well with other detachable printer components such as printheads, ink/printhead cartridges, and the like. Thus, having here described preferred embodiments of the present invention, it is anticipated that other modifications may be made thereto within the scope of the invention by individuals skilled in the art. Thus, although preferred and alternative embodiments of the present invention have been described, it will be appreciated that the spirit and scope of the invention is not limited to those embodiments, but extend to the various modifications and equivalents as defined in the appended claims.